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OUR UNIVERSITIES AND RESEARCH

IN early colonial days there was but one course of study for all who entered an American college, and at its completion the candidate for a degree was required to translate the bible interchangeably into Hebrew, Latin, Greek or English. The culture of a long-past age was the sole concern of the college, and it heeded not the problems of the commonplace world beyond its walls. Its atmosphere was quite uncongenial to research, and the men of science of colonial times and of the several decades thereafter were commonly unconnected with the colleges.

Without aid or substantial recognition from our colleges, Harriot, Byrd, Clayton, Rittenhouse, Franklin, Wilson, Audubon, Rumsey, Fulton and Stevens strove or wrote. Indeed, of all the scientific worthies of those days John Winthrop, of Harvard, and Samuel Mitchill, of Columbia, were almost the only ones of note who labored within the shelter of the college.

With the birth of the republic, however, the most progressive of our colleges began to give courses in the sciences, and it was then that the spirit of research, which had already been fostered into being by men of culture of the outer world, made its first timid entrance within the college walls.

The efforts of its votaries attracted little or no official action on the part of the colleges for the expense involved in the prosecution of research in those early days was so slight that the professors themselves, small as their salaries were, could readily afford to meet them. Simple apparatus mainly the design of their own skilled hands, served Franklin and Henry for

their great discoveries, and I well knew a college professor of thirty years ago whose noteworthy researches in physics were performed always with inexpensive apparatus, almost wholly of his own construction. Nor was his case exceptional; it was almost the rule in our fathers' days.

To-day, the refinement of methods is rendering it impossible for the private investigator to purchase or even to construct the elaborate apparatus he requires.

The independent self-reliant investigator is vanishing, and his successor is becoming dependent in ever-increasing measure upon larger means than those of his own possession for the prosecution of research. Men of science are becoming trustees, not proprietors of the funds required for the expenses of investigation, and thus it is that our productive students are yearly becoming more and more dependent upon the university or the endowed institution, and the attitude of these bodies toward research is becoming of greater and greater importance to mankind, for the hope of civilization lies in him who sees the light beyond the confines of our knowledge of to-day.

Too many of us still believe the fostering of research to be a mere detail of secondary importance, but it is in fact of vital primary importance to each and every one of us, and its utmost advancement is a necessary and absolute duty for those who control the destinies of our colleges.

I fear it will be all too apparent to those who have the highest welfare of science at heart that our colleges have not yet awakened to a sufficient realization of the importance of research or of their heavy responsibility in the matter of its advancement. President Eliot in his recently published book upon "University Administration" presents in his masterly manner the wisdom gained through a lifetime of experience, yet not in one paragraph does he deal with the special relation of the university toward research. The American university remains to-day the overgrown college, and conservation of the old rather than the revelation of new truth is its ideal.

But to return to the brighter side of the picture; the growing dependence of the individual investigator upon the university is in itself a good thing, for his conscience must awaken to a sense of increased personal responsibility. His position is becoming that of a highly trusted servant of mankind, no longer the free follower of a mere impulse to explore. Through this dependence upon the college, the investigator becomes most happily surrounded by young minds whose leading spirit he should be. Intellectually nothing is more democratic than the atmosphere of the research laboratory wherein the finely trained but relatively inelastic mind of the master is complemented by the fresher view and greater daring of his pupils' thoughts. Of all collegiate aims, I would place next in importance to the strengthening of character the fostering of that freedom of thought and that masterly self-dependence which come only through earnest devotion to research.

Thus the new conditions are increasing the personal responsibilities and deepening the sphere of influence of the investigator, and in like ratio do they add to the burden of the responsibility of the university toward him to grant the opportunity he may use so well for the benefit of the world at large.

Our leading institutions have already begun to awaken to a realization of their duty toward research, but in many respects the position of the investigator within the college is still handicapped through the lingering traditions and aims of an age wherein his presence was but coldly welcomed.

We should realize that there are, broadly

speaking, two sorts of men in the *personnel* of every faculty, and while every successful professor must be an enthusiastic student and an inspiring teacher, some are mainly erudite, while others are productive of discoveries in science. While the needs of these two classes of men are mainly in accord, in some important respects they are at variance.

From the nature of the case, the merely erudite must greatly outnumber those whose genius is directed with success toward discovery, and thus the needs of the teacher have been well provided for, whereas the investigator finds his task rendered harder through the imposition of duties which, while precious in the opportunity they afford to the teacher are of a character to interfere with that freedom of action which is so essential to productive work in science or in art.

The teacher's happiest opportunity is in meeting students of the primary classes. It is also well for him to teach in the vacation school in order that his store of knowledge may become accessible to the many; but an atmosphere in which these ideals predominate to the exclusion of other aims is not favorable to the welfare of the productive student, for his disposition peculiarly befits him to perfect the training of the gifted few rather than to reiterate old truths for the enlightenment of the many. The American college has been justly solicitous for the welfare of the average student, but the requirements of the most gifted and original are in some measure sacrificed, and it is not due to accident that our colleges have not yet developed a man of science of the highest European type. For example, the extraordinary increase in the number of summer schools maintained by our universities has been adverse to the welfare of the investigator, forcing him as it does to the time-consuming task of primary teaching during a period when he should be most free to devote his attention to research. Owing to the paucity of their salaries, labor in summer schools is practically forced upon the young instructors, and this factor has become so serious a one that it is now the most pernicious single influence tending to defeat the development of the research spirit in the teaching force of our universities, stultifying as it does many a promising young man at the beginning of his career in science.

It is essential for the welfare of research within our universities that graduate schools shall maintain as an ideal the fostering of productive scholarship, rather than the mere training of college teachers, and the holders of professorships in our graduate schools should above all be successful investigators, for they will then be inspiring teachers.

Our universities have often been deterred from the most effective encouragement of research or have entered only half-heartedly into it, owing to the large expense involved, and thus many of our graduate schools are still mainly training institutions for college and high-school teachers.

In 1880 our colleges were housed in simple brick structures, whereas to-day they are domiciled in palaces. This material change has necessarily been disproportionate to their intellectual development during the same period, and those who have the welfare of the colleges at heart have had it brought forcefully to their attention that grand buildings and beautiful lawns may be necessary and are certainly desirable, but a university is made by a faculty of earnest and eminent men. Fair, intelligent, generous treatment their cause demands, for their very unselfish high-mindedness renders them peculiarly liable to be the prey of narrow exploiters of the mere commercial side of education.

It will be necessary for our colleges to offer a more attractive career to their professors, especially in the enlargement of opportunity for individual freedom of intellectual effort. This is more important than any increase in salaries, for the ablest men strive to serve mankind rather than to seek money. It is true, as President Eliot states, that "in the United States the profession of teaching and scientific research offers absolutely no money prizes." The middle ages looked complacently upon the beggar student and this spirit survives to-day in many a college trustee's easy tolerance of the poor salaries paid to famous teachers whose names will be remembered as leaders of our race long after his own has perished; but insufficient though their material support may be, it is of vastly more importance for us to improve their *opportunities* to be useful in respect to their peculiar individual abilities. This omnipotence of the effective individual is the key-note of the success of the German university system. German students seek individual professors—whereas ours commonly enter college ignorant of the names and even heedless of the scholarly reputations of their teachers.

The most serious effects of a bad system are often the most obscurely seen and difficult to detect, and it may safely be said that the most pernicious result of the treatment now accorded him who devotes his life to pure science is that it deters many an able young man from entering upon a career of research. When he leaves the university he elects to follow law or commercial pursuits, and hopes thereby to gain the competence which will enable him to reenter the ranks of men of science with all the great advantages of personal independence; but the habits of another life overwhelm him—he never returns and is lost to science.

Alfred Goldsborough Mayer

THE SHEFFIELD MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

On the last day of this month the British Association for the Advancement of Science will begin at Sheffield its eightieth annual meeting. Only once before in its history has the association met there. That was in 1879, when Professor G. J. Allman, M.D., F.R.S., the then president of the Linnæan Society, assumed the presidency of the association in succession to Mr. W. Spottiswoode, and the list of sectional presidents included such well-known names as Mr. G. Shaw Lefevre (economic science), Professor Dewar (chemistry), Mr. Clements Markham (geography) and Professor St. George Mivart (biology).

The extent to which the problems of to-day were even then attracting attention is shown by the subjects of the evening lectures, it being recorded in the annals of the association that Mr. W. Crookes, F.R.S., discoursed on Radiant Matter, Mr. W. E. Ayrton lectured to the operative classes on "Electricity as Motive Power," and Professor E. Ray Lankester, F.R.S., discussed the question of degeneration. But though the former Sheffield meeting fully sustained the high reputation of the association on its scientific side, only 1,404 members and associates were attracted to the meeting. A smaller attendance has been recorded at only seven meetings during the past half century. The forthcoming meeting ought to bring together a much larger number of members and associates. The presidential addresses, the lectures, discussions and many of the individual papers promise to be of great interest and

[1] The London *Times* prints annually a forecast of the meetings of the British Association for the Advancement of Science, compiled with the cooperation of the officers of the association. We reprint this sketch as the best available account of the forthcoming meeting.

value; the social functions that have been arranged are both numerous and attractive, and show that the association is assured of the same generous measure of hospitality and entertainment in Sheffield that it has received elsewhere in its peripatetic career.

Sheffield has gone ahead by leaps and bounds since it was last visited by the British Association. In 1879 its population was about a quarter of a million; now the population is estimated to be nearly twice as large, and the municipal area is the largest in the kingdom. During the interval Sheffield has become a county borough (in 1888), and in 1893 the jubilee of its corporation was made notable by its creation as a city. Five years ago its university was established by royal charter, the opening ceremony being performed by King Edward VII., who was accompanied by Queen Alexandra. The new university library, the gift of a local benefactor, Mr. W. Edgar Allen, is just a year old, and was opened by their present majesties, King George and Queen Mary, while still Prince and Princess of Wales. It is interesting to note that Firth College, out of which the university has developed, was established in the year of the association's last visit to Sheffield. The town hall, erected at a cost of £182,000, is only one of many other handsome public buildings which have come into existence in the past thirty years, and have done away with much of the ground for Horace Walpole's reproach that Sheffield was "one of the foulest towns of England in the most charming situation." The city is still, of course, essentially a great manufacturing center, and from the picturesque point of view suffers from the defects of its industrial activity; but the proportions of its streets and the character of its buildings have been vastly improved in recent years, and the Sheffield of to-day is not behind any of its northern neighbors in respect of municipal enterprise. And though the modern development of its iron and steel industries is the most distinguishing feature of the city, Sheffield is not without historical interest. The Cutlers' Company has enjoyed legal recognition for nearly three hundred years, its charter of incorporation dating back to 1624, and there is no doubt that it existed long before it was incorporated, just as Sheffield itself was certainly famous in the middle ages for its cutlery—witness "The Canterbury Tales," in which the Reeve says of the Miller in his tale: "A Sheffield thwitel baar he in his hose."

By the courtesy of the Cutlers' Company the reception-room and administrative offices of the British Association during the forthcoming meeting will be in the Cutlers' Hall; and with the exception of Section I (physiology), which will be located in the university, all the sections will have rooms within a radius of less than a quarter of a mile from that hall. The Local Arrangements Committee is to be congratulated on having succeeded in accommodating the numerous sections within such a short distance of one another, not only because there are many members of the British Association of an eclectic turn of mind, who like to attend the proceedings of more than one section, but because, in continuation and development of a practise which demonstrates the close interrelation of the different branches of science, which has been growing in favor in the British Association in recent years, there are to be a large number of joint meetings of two or more sections for the discussion of questions of common interest. This tendency is deserving of every encouragement.

For some time past the council of the British Association has had under con-

sideration the advisability of reorganizing the work of the sections. Hitherto the sectional proceedings have mainly been devoted to the reading of individual papers on points of particular interest. This practise has served its purpose in the past, but in these days of growing specialization it is open to serious abuse, and it is a question whether the whole scheme of the association's meetings should not be revised with a view to its adaptation to modern requirements. The need is for lectures rather than papers, in which shall be set forth in as simple language as possible, for the benefit of the educated and intelligent public, who yet are not specialists, the progress that is being made in the several branches of science. Otherwise the meetings tend to become a series of provincial gatherings in which the various scientific societies assemble in extra session, repeating in holiday fashion their London proceedings. A step in the right direction reversing this tendency has been taken during the past few years by some of the sections, which have instituted afternoon lantern lectures of a semi-popular character. The holding of joint meetings between the sections for the discussion of questions of wide interest and importance is another welcome sign of appreciation of the need for adaptation to changing conditions. The endeavor which has been made in drawing up the program of the Sheffield meeting to meet this need will be apparent from the details given below of the sectional arrangements; but much remains to be done, and the question will no doubt continue to engage the attention of the council.

The meeting will open on the evening of Wednesday, August 31, in the Victoria Hall, where the retiring president, Professor Sir J. J. Thomson, F.R.S., will introduce his successor, Canon T. G. Bonney, F.R.S., who will then deliver his presidential address. In the Victoria Hall, also, will be delivered the evening discourses to the association on the following Friday and Monday. The first of these will be by Professor William Stirling, who has selected as his subject "Types of Animal Movement," and the second by Mr. D. G. Hogarth, whose discourse will be on "New Discoveries about the Hittites." In the Saturday evening lecture to the operative classes, Mr. C. T. Heycock will deal with metallic alloys. On the evening of Thursday, September 1, the lord mayor (Lord Fitzwilliam) and Lady Fitzwilliam will hold a reception in the town hall, and later in the meeting they will entertain the association at an afternoon garden party at their seat at Wentworth. An afternoon garden party will also be given by the local committee in the Botanical Gardens, and on the evening of Tuesday, September 6, the local committee will hold a reception in the Mappin Art Gallery, on the opposite side of Western Park to the university, where simultaneously a reception will be held by the chancellor of the university (the Duke of Norfolk) and the Duchess of Norfolk. Various social functions on a smaller scale have been arranged, while members who are interested in the great metallurgical and mechanical industries for which Sheffield is famous will be afforded numerous opportunities of inspecting the leading foundries and workshops. The Saturday in the middle of the meeting will, as usual, be devoted to excursions to various places of interest in the neighborhood, including Chatsworth and Haddon Hall, Welbeck and Thoresby, Hardwick and Bolsover Castle, Clumber and Rufford.

The British Association has already accepted an invitation to hold its meeting next year at Portsmouth, and one of the

duties of the general committee at Sheffield will be to consider the place of meeting in 1912. Although it was only last year that the association went abroad to Winnipeg, it is understood that it will be invited again to leave these islands in 1912, this time for the purpose of bringing Australia within the range of its influence.[2] Since the association, with many misgivings and in the face of strong opposition, accepted an invitation to visit Montreal in 1884, the principle of varying its meetings in the United Kingdom by occasional flights to the oversea dominions has become firmly established. Two subsequent visits have been paid to Canada—to Toronto in 1897 and Winnipeg last year—and one to South Africa in 1905. There is no doubt that these visits serve a useful purpose in bringing colonial students into touch with the leaders of British scientific thought, and give a valuable stimulus to the pursuit of scientific knowledge in the empire oversea. Proposals that the British Association for the Advancement of Science should meet in Australia have been urged privately for many years past, but the length of the voyage and the cost of such a tour have hitherto seemed insuperable objections. Now that the commonwealth and state governments are alive to the importance of making better known the vastness of Australia's economic resources, and the many attractions it has to offer to the right class of visitor and immigrant, the financial difficulty might be partially met by official grants-in-aid.

The question of time remains a serious obstacle. At least each of the state capitals would require a visit, and the return journey could hardly be completed in less than four months. Most of the members of the British Association are busy men, with their livings to earn, and many would be unable to spare the time for such an extended absence from this country. The attractions of the tour, however, would no doubt induce all who possibly could to make an effort to get away. Speculation as to the number is not very helpful; and with the object of giving some sure basis to go upon the council of the association has issued a circular to a number of the leading men of science in this country, requesting each to state whether, in the event of an invitation to visit Australia being received and accepted, he would be able to take part in the meeting. The result of this canvass is awaited with interest, and it must be hoped that it will justify the general committee in giving favorable consideration to the proposed invitation. The British Association is not, and can not hope again to be, the force it once was in the scientific world, but it still deserves its name as the British Parliament of Science. As a missionary agent for the advancement of scientific knowledge in the self-governing dominions of the empire it has an extended field of usefulness before it; and in these days of ever-increasing facilities for world travel Australia ought not to remain indefinitely outside the association's itinerant course.

The wide range of the association's interests and the valuable medium which its proceedings afford for the discussion of scientific questions of the day are once again shown by the program of the Sheffield meeting. Canon Bonney, the president-elect, as emeritus professor of geology in University College, London, and a former president of the Geological Society, may be expected to devote his inaugural address to the discussion of some aspect of geological science. He is perhaps best known as a student of petrology; but

[2] The meeting in Australia will probably be held in 1913 or 1914. In 1912 the association is likely to meet at Dundee.—ED. SCIENCE.

before he took up that branch of the subject he was an interested observer of the action of ice on the surface features of a country, and there is reason to believe that the main subject of his address will be the evidence for the work of ice and its nature in Britain and the parts of Europe that are more or less in physical relation with these islands. An ardent Alpinist, some time president of the Alpine Club, he has spent in the course of some thirty holidays considerably more than two years in the Alps, and has also visited the Pyrenees, Scandinavia and the mountainous regions of Germany, besides doing much work in the British Isles in the endeavor to determine the extent of the effects of ice action (so far as this can be determined by reasoning from observed facts) in producing or modifying the physical features of a country and the kind of materials which are signs of the former presence of ice in a country. He is specially interested in the explanations which have been proposed of the condition of the British Isles in the great ice age; and it may be conjectured that he will discuss these explanations severally, not to advocate the claims of any one, but to point out what are the strong and what are the weak points in the hypotheses that at present hold the field. Cautious observers can scarcely have failed to notice the growing tendency in recent years to treat mere hypotheses as if they were axiomatic truths established by indubitable observations, and as if they afforded a safe basis for reasoning. Professor Bonney is known to be opposed to such methods; and it may be surmised that he will seek to winnow out some of the chaff of fancy from the grain of fact, and to bring into clear relief the difficulties with which the advocate of any one view of the condition of these islands during the ice age has to contend. He himself, it is understood, is not yet prepared to pronounce a definite opinion on the subject, taking as he does the view that there is more to learn before a decision can be reached.

For the following particulars of the sectional programs we are indebted to the sectional presidents and recorders.

The president of Section A (mathematical and physical science) is Professor E. W. Hobson, F.R.S. His presidential address will consist of some remarks on the scope and aims of modern mathematics, with some observations on the relations between mathematicians and physicists. The address will also contain some discussion of recent changes in the teaching of the more elementary parts of mathematics. In the subsequent proceedings of Section A importance attaches to the joint meetings which have been arranged with other sections. In one of these, to be held jointly with Section B (chemistry) and G (engineering) on the morning of Friday, September 2, the report of the Gaseous Explosions Committee will be discussed, and a number of papers dealing with combustion will be presented for consideration. The section will again meet jointly with Section G on the following Monday, when Professor G. H. Bryan, F.R.S., will open a discussion of great topical interest and importance on "The Principles of Mechanical Flight." On the Tuesday the section is to discuss some of the problems of Atmospherical Electricity, the opener being Dr. C. Chree.

In his presidential address to Section B (chemistry) Mr. J. E. Stead, F.R.S., will deal with the chemical phenomena connected with the effect of sulphur and silicon on the carbon condition in commercial cast iron. After reviewing the work of others in this connection, he will state the results of much of his own original re-

search work, which go far to explain why it is that sulphur in cast iron tends to make it white, and why silicon tends in the opposite direction. Reference has already been made to the meeting which the section will hold jointly with the Sections A and G on Friday, September 2. The following Monday morning will be devoted to a joint meeting with Section I (physiology) and K (botany), for the purpose of a discussion on the subject of the "Bio-chemistry of Respiration"; while in the afternoon the "Neglect of Science by Commerce and Industry" will be considered in conjunction with Section L (educational science). The sitting of Tuesday, September 6, it is proposed to devote to the consideration of papers of a metallurgical interest. Contributions to this day's proceedings have been promised by Professor Arnold, F.R.S., on "A Fourth Recalescence in Steel"; Professor McWilliam on "The Influence of Chemical Composition and Thermal Treatment on the Properties of Steels"; Dr. S. Monckton Copeman, F.R.S., on "Ferro-Silicon"; Dr. S. N. Friend, on "The Corrosion of Iron and Steel"; Dr. Rosenhaim, and Professor Howe.

Professor H. E. Armstrong hopes to contribute a paper on "The Provident Use of Coal," in which he will raise the important question of using coal in such a way that the valuable constituents—gas, volatile substances, pitch, coke—are all, as far as possible, got out of it. This is a problem of national importance, and it will be interesting to see how far Professor Armstrong is able to advance its practical solution. Two reports will be presented to the section, one on "Combustion" by Professor Bone, F.R.S., and the other on "Solubility," by Dr. S. V. Eyre. Professor Bone will also describe and demonstrate a new method of heating by gaseous combustion, and its industrial application. The report and demonstration will be especially interesting in connection with the joint meeting for the discussion of such questions with the physicists and engineers. From the Sheffield University Chemical Laboratory papers in organic chemistry have been promised by Professor Wynne, F.R.S., and Dr. S. F. Thorpe, F.R.S., and in physical chemistry by Mr. W. E. S. Turner and others.

Mr. A. D. Hall, F.R.S., director of the Rothamsted Experimental Station of the Lawes Agricultural Trust, is this year chairman of the agricultural subsection, which is attached to Section B. He will devote his chairman's address to a history of opinions as to the causes of the fertility of the soil. After allusion to the men of the seventeenth century—Kenelm Digby and Evelyn—who fixed on the niter of the soil as the source of its fertility, he will proceed to the early nineteenth century, when the first exact knowledge of the nutrition of the plant was obtained. This will lead to the chemical theory of the soil with Daubeny's distinction between dormant and active plant food, and the more recent developments of such a theory. The breakdown of this hypothesis led to another theory that regarded all soils as possessing an excess of plant food, their behavior towards water being the factor which made them fertile or unfertile. A development of this latter theory has been to regard plants as excreting toxins injurious to themselves, so that an unfertile soil is one laden with the products of the previous growth of the same class of plants. With the discovery of bacteria in the soil a theory grew up which regarded fertility as due to the rate at which the soil could produce nitrates; a later development of this theory has arisen through the discovery in the soil of protozoa, which by keeping down the number of bacteria limit the

production of available nitrogen compounds, and therefore the fertility. The conclusion reached by Mr. Hall is that no one factor can be found which determines fertility; it must be taken as the resultant of many and often conflicting actions.

As is the case with so many other sections this year, joint meetings with the representatives of other branches of science form a prominent feature in the program of the agriculturists. The object is to obtain outside suggestions and criticisms on questions that are now assuming considerable importance in agricultural research. Thus the question of magnitude of error in an agricultural experiment will be discussed in conjunction with Section F (economic science and statistics), papers being contributed by Messrs H. E. Armstrong, T. B. Wood, A. B. Bruce, R. W. Berry, S. H. Collins, A. D. Hall and E. J. Russell; the question of soil surveys in conjunction with Section C (geology), papers being promised from the Rothamsted, Bristol and Cambridge laboratories; and the question of the effect of organisms other than bacteria on soil fertility in conjunction with Section D (zoology), papers by Dr. E. J. Russell and Mr. W. B. Hutchinson. Probably the most popular subject for discussion will be the growth of sugar beet in England, on which papers have been promised by Mr. G. L. Courthope and Mr. Sigmund Stein. Some recent phases of the problem of nitrogen fixation by bacteria will be discussed by Professor Bottomley and Mr. John Golding. Among individual papers, as distinct from contributions to general discussions, may be mentioned "Scientific Breeding of Live Stock," by Mr. K. J. J. Mackenzie, of Cambridge; "Effect of Town Atmosphere on Vegetation," by Dr. Crowther, of Leeds; "A Bacterial Disease of Potatoes," by Mr. A. Howe, of Armstrong College, Newcastle-on-Tyne; and "Costs of Danish Farming," by Mr. Christopher Turnour.

The program of Section C (geology) has been arranged in some detail. Four papers are announced for Thursday, September 1, before the delivery of Dr. A. P. Coleman's presidential address. These are "The Yordale Series and its Equivalents Elsewhere," by Mr. Cosmo Johns; "The Paleozoic Rocks of Cantley (Sedbergh)," by Dr. J. E. Marr, F.R.S., and Mr. W. G. Fearnsides; "The Graptolitic Zones of the Salopian Rocks of the Cantley Area (Sedbergh)," by Miss G. R. Watney and Miss E. G. Welch; and "Pleochroic Halos," by Professor J. Joly, F.R.S. After the presidential address papers will be read by Dr. C. H. Lees, F.R.S., on "Mountain Temperatures and Radium"; Mr. F. D. Falconer, "Outlines of the Geology of Northern Nigeria"; Mr. W. Parkinson, "Notes on the Geology of the Gold Coast"; and Mr. Cosmo Johns, "The Geological Significance of the Nickel-Iron Meteorites." Friday's proceedings will be devoted to joint discussions with Section E (geography) on various subjects of local interest. There will first be a discussion on the geography and geology of the Sheffield district, to which contributions have been promised by Mr. Cosmo Johns ("The Local Geology"), Mr. H. Culpin ("The Marine Bands in the Coal Measures of South Yorkshire"), and Mr. W. H. Dyson ("The Maltby Deep Boring"). This will be followed by a discussion on the economic products of Sheffield as affected by the structure of the district. In this connection Professor A. McWilliam is expected to read a paper on "The Metallurgical Industries in Relation to the Rocks of the District." The remainder of the day's proceedings will be devoted to the consideration of regional surveys. Papers have been promised by Mr. T. Sheppard, on "The Humber during

the Human Period," and Mr. O. Crawford, on "The Andover Region." For Monday, September 5, papers are announced on "Thrust Masses in the Western District of the Dolomites," by Dr. W. M. Ogilvie-Gordon; "The Geology of Cyrenaica," by Professor J. W. Gregory, F.R.S., and "The Geology of Natal," by Dr. F. H. Hatch. Dr. John Milne, F.R.S., will present the report of the seismological committee, and the closing part of the sitting will be devoted to the joint discussion with the agricultural subsection on "Soil Surveys," to which reference has already been made. Tuesday's proceedings will include two short lantern lectures by Dr. Tempest Anderson, one entitled "Kilauea and its Lessons," and the other, "Some Volcanic Phenomena in New Zealand." There is also announced what should be an important discussion on the concealed coalfield of Nottinghamshire, Derbyshire and Yorkshire, the openers of which will be Professor P. F. Kendall and Dr. Walcot Gibson.

One of the most interesting features in the proceedings of Section D (zoology) will be an afternoon lantern lecture by Dr. Hans Gadow, F.R.S., on "Coral Snakes and Peacocks." Reference has already been made to the joint meetings arranged with the agriculturists for the discussion of some of the problems of soil fertility. Other papers have been promised by Professor Marcus Hartog, on "Mitokinatism and the Electro-colloid Hypothesis"; by Professor C. J. Patten, on "Semination in *Calidris Aronaria*," a key to some of the problems regarding its migratory movements during the breeding season; by Professor Garstang, on "Some Experiments and Observations on the Colors of Insect Larvæ"; by Dr. Edward Hindle, on "A Cytological Study of Artificial Parthenogenesis"; by Dr. H. B. Fantham, on "Avian Coccidiosis"; by Dr. Jenkinson, on "Relation of Regenerated and Developmental Processes"; by Dr. E. H. J. Schuster, on "First Results from the Oxford Anthropometrical Laboratory"; and by Dr. H. W. Marett Tims on "Development of the Pectoral Girdle in *Acanthias vulgaris*."

The president of Section E (geography) is Professor A. J. Herbertson, of Oxford. In his presidential address he proposes, after a brief review of the progress of geography during the past ten years, especially educational progress, to attempt to elucidate the scope and functions of geography, about which there are many misconceptions. He will also discuss the future of geography, more particularly as a subject of research, in its bearings on practical questions. The special feature of the sectional proceedings, apart from the president's address, will be the joint meeting with the geological section, already alluded to. Among papers of varied interest that have been promised, mention may be made of an account by Colonel R. T. Bright, of the new Uganda-Congo Frontier; a discussion of the problems of the Nile Alluvium, by Captain H. G. Lyons; a description by Dr. W. S. Bruce, of Prince Charles Foreland, Spitzbergen, and an account by Captain Davies, of the Voyage of the *Nimrod*. Mr. J. W. Hayward, of Montreal, will contribute a paper on "The Cattle District of Queensland," and Mr. J. W. Falconer one on "The Rivers of Northern Nigeria," while nearer home, the Mitchelstown Caves and the underground waters of the Castleton District will be described by Mr. C. A. Hill and Mr. H. Brodrick respectively.

In his presidential address to Section F (economic science and statistics) Sir H. Llewellyn Smith will deal with various aspects of recent tendencies of economic

thought and research, both as regards the methods employed and the ultimate objects sought. In regard to the latter point particular stress will be laid on the growing tendency to attach importance to the study of ends as distinct from means. In illustration of this point reference will be made to the increasing importance attached to economic security as an end to be consciously pursued—a tendency which finds expression in the vast modern developments in the method of insurance. An attempt will be made to find criteria for determining how far and in what sense and within what limitations this tendency is a healthy one. As a particular example the question will be discussed how far the risks of unemployment can properly be regarded as insurable risks, having regard to the criteria laid down, and how far it is possible and expedient to apply the method of insurance to some or all of these risks. This discussion will lead to the formulation of certain principles which suffice to determine, within comparatively narrow limits, the lines and scope of any economically practicable scheme for insurance against unemployment.

Professor W. E. Dalby, dean of the City and Guilds Central Technical College, who is this year president of Section G (engineering), will devote his address to the consideration of various questions relating to British railways. Of much interest and importance in the general proceedings of the section will probably be the joint discussion with the mathematical and physical science section on aerial flight, and the joint discussion with the chemical section on combustion. The report of the Gaseous Explosions Committee will also come up for consideration. Separate papers have been promised by Professor Ripper on "The Testing of the Lathe Tool Steels" and "A New Method of Testing the Cutting Quality of Files"; Mr. W. A. Scoble, "Experiments on Aeroplanes"; Mr. H. S. Wimperis, "Accelerometers"; Professor Coker, "Optical Determination of Stress"; Professor S. P. Thompson, F.R.S., "Laws of Electro-mechanics"; Mr. Philip Dawson, the "Electrification of the Brighton Railway," and Mr. F. Bacon, "Heat Insulation."

In his presidential address before Section H (anthropology) Mr. W. Crooke intends to discuss the possibility of improving, by a course of anthropological training before they join their appointments, the qualifications of young officers appointed to the Indian and Colonial services. As a development of this the future organization of ethnographical surveys throughout the empire under the control of experts will receive consideration. Assuming that such a course is applied to India, Mr. Crooke will discuss certain questions which are not likely to be solved by any other method, such as the relation of the present population to the prehistoric culture of the country, and the origin and development of the distribution of caste.

A large number of descriptive papers will, as usual, be presented to the section; but perhaps the most noteworthy feature of the program is the devotion of the Friday sitting to a joint discussion with Section L (educational science) on "Certain Aspects of Educational Research." On behalf of Section L, Professor J. A. Green, of Sheffield, the secretary of a committee which has been investigating the mental and physical factors involved in education, will present a report on the present position of educational research at home and abroad. Dr. Gray will also present a report on behalf of a committee of the Anthropological Section on methods of observing and measuring mental characters. It is hoped that Professor Münster-

berg, of Harvard, will open the discussion, in which Dr. Lucy Hirsch Ernst, Professor Lippman, of Berlin, Dr. Kerr, the principal medical officer of the London County Council, and several members of his staff, Professor C. S. Myers, Dr. T. P. Nunn, Dr. Rivers, of Cambridge, and others, have signified their intention to take part. Reports will be presented by the investigators, of serial observations on school children and others, which have been conducted in London, Liverpool, Sheffield, Wolverhampton and elsewhere.

Apart from the joint discussion with the chemical and botanical sections on "The Biochemistry of Respiration," the provincial arrangements of Section I (physiology) include a joint discussion with the educational section on voice production. There will further be a discussion on caisson disease, to be opened by Dr. Leonard Hill, F.R.S., while Professor C. S. Sherrington, F.R.S., has promised a paper on "Reflex Standing and Walking."

In Section K (botany) the papers are generally distinguished by their severely technical character. The program of the section for the Sheffield meeting forms no exception to the rule; but, as in former years, the proceedings will be relieved on one afternoon by a semi-popular lecture. This will be delivered by Professor F. O. Bower, who has chosen the attractive title, "Sand Dunes and Golf Links." Papers have also been promised by Professor Bower (*a*) on "Two Synthetic Genera of Filicales"; (*b*) "Note on *Ophioglossum palmatum*"; by Dr. F. Darwin, on a new method of estimating the opening of stomata; Mr. S. Maugham, the "Paths of Translocations of Sugars from Green Leaves"; Professor F. W. Oliver, on the "Pollen Chambers of Fossil and Recent Seeds"; Mrs. Thoday, the "Morphology of the Ovules in *Gnetum* and *Welwitschia*"; Dr. M. C. Stopes, "Further Observations on the Fossil Flower"; Mr. Harold Wager, "Chromosome Reduction in the Hymenomycetes"; Professor V. H. Blackburn, on the "Sexuality of *Polystigma rubrum*"; Professor Farmer and Miss Digby, on "Telophases and Prophases in *Galtonia*"; Dr. Lloyd Williams, the "Zoospores and Trumpet-hyphæ of the Laminariaceæ"; Mr. M. Wilson, "Plant Distribution in the Woods of Northeast Kent"; Mr. A. S. Horne, on the "Absorption of Water by Leguminous Seeds"; Dr. H. C. J. Fraser is also contributing a cytological paper. Mention has already been made of the joint discussion with the chemists and physiologists on the biochemistry of respiration.

As president of Section L (educational science), Principal H. A. Miers, F.R.S., will take as the subject of his inaugural address "A Distinction between University and School Methods of Education." In it he will suggest that many of the present failures of our educational system are due to the fact that university methods are too often used at school and that school methods are too often retained at the university; that at the university preparatory work should no longer be required, but that the student should be brought into an atmosphere of inquiry, in which he is from the very beginning made to feel responsible for his work. He will urge that this change of method should be sudden and complete, and preparatory courses of training should be entirely abandoned, and that the method of teaching a trained mind should be entirely different from that which is employed with the untrained minds of children. The Educational Section has always aimed at confining its proceedings mainly to the discussion of questions of wide interest and outstanding importance, and this year it has managed its full share of joint meetings with other sections. The arrange-

ments for the meeting with the anthropologists for the discussion of questions of educational research have been described under Section H.

The joint discussion with the chemistry section on the neglect of science in commerce and industry will be opened by Mr. R. Blair, the Education Officer of the London County Council, and Professor Bovey, F.R.S., Principal E. H. Griffiths, F.R.S., Sir William Tilden, F.R.S., and others have promised to take part. This will be in the afternoon of Monday, September 5.

The joint meeting of the physiologists for the discussion of voice production will occupy the afternoon of the following day, and papers have been promised by Dr. A. A. Gray, Principal Barrell, of Isleworth, Professor Wesley Mills, Mr. W. H. Griffiths and Miss Ormée, of Sheffield. Within the section itself will be discussions on handwork and science in elementary schools, to be opened by Mr. J. G. Legge, director of education in Liverpool; and open-air studies in schools of normal type, to which contributions have been promised by Mr. J. E. Feasey, of Sheffield, Mr. G. G. Lewis, of Kentish Town, and Professor Mark R. Wright, of Newcastle-on-Tyne ("A Training College under Canvas").

In accordance with the usual practise, visits to schools and other educational institutions of interest will be arranged during the meeting.

THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS

The twenty-seventh convention of the Association of Official Agricultural Chemists will be held in Washington, D. C., at the Raleigh Hotel, opening on November 10, at 9 o'clock. As the hotel will provide a large hall on the top floor of the building for the convention, as well as other facilities for the meeting, it is urged that the members make the Raleigh their headquarters, if possible, and reserve their rooms a few days in advance.

ORDER OF BUSINESS

Thursday, November 10.

Morning session: Phosphoric acid; Nitrogen; Potash; Soils; Inorganic plant constituents.

Afternoon session: Appointment of committees (resolutions, etc.); Insecticides; Water; Committee A on recommendations of referees; reports of special committees—(amendments to constitution; appropriation; availability of phosphoric acid; compilation of by-laws; food standards; unification of terms; standardization of alcohol tables; testing of chemical reagents; unification of methods of analysis of fats and oils).

Friday, November 11.

Morning session: Food adulteration (reports to be called for in order given in list of associate referees).

President's address (special order for 12 o'clock).

Afternoon session: Food adulteration continued. Separation of nitrogeneous bodies (meat proteids; milk and cheese proteids; vegetable proteids). Committee C on recommendations of referees .

Saturday, November 12.

Morning session: Dairy products; foods and feeding stuffs; Sugar (chemical methods and molasses methods); Committee B on recommendations of referees; committees (resolutions, constitution, etc.); Tannin.

Afternoon session: Drugs and medicinal plants.

H. W. Wiley,
Secretary

Washington, D. C.,
August 13, 1909

SCIENTIFIC NOTES AND NEWS

Professor Edward C. Pickering, director of the Harvard Observatory, was reelected president of the Astronomical and Astrophysical Society of America at the meeting held in Cambridge on August 19. The other officers of the society, also reelected for the ensuing year, are: *First Vice-president,* George C. Comstock, University of Wisconsin; *Second Vice-president,* W. W. Campbell, director of

the Lick Observatory; *Treasurer,* C. L. Doolittle, University of Pennsylvania; *Councillors,* Frank Schlesinger, Allegheny Observatory, and W. J. Humphreys, Washington, D. C.

OFFICERS of the Harvey Society for the coming year have been elected as follows: *President,* Dr. Simon Flexner; *Vice-president,* Dr. John Howland; *Treasurer,* Dr. E. K. Dunham; *Secretary,* Dr. Haven Emerson; *Council,* Dr. Graham Lusk, Dr. S. J. Meltzer and Dr. James Ewing.

DR. ERNST STAHL, professor of botany at Jena, has been elected a corresponding member of the Vienna Academy of Sciences.

DR. W. J. HOLLAND, Professor Herbert Osborn and Dr. Henry Skinner represented the Entomological Society of America at the first International Congress of Entomology, held this month at Brussels.

PROFESSOR WILLIAM R. SHEPHERD, of Columbia University, has been chosen as representative of American universities at the Scientific Congress now being held at Buenos Ayres.

PROFESSOR A. G. WEBSTER has sailed for Europe, where he will represent Clark University as delegate to the centennial celebration of the University of Berlin.

PROFESSOR FREDERIC S. LEE, of Columbia University, will be a guest of the British Association for the Advancement of Science at its Sheffield meeting. Later he will take part in the proceedings of the International Physiological Congress in Vienna.

PROFESSOR FRANCIS E. LLOYD is spending the month of August at the Desert Botanical Laboratory, Tucson, Ariz., continuing his studies of transpiration and stomatal movement in ocotillo, *Fouquieria splendens.*

IN view of the removal of the work of the British Meteorological office to the new building in Exhibition-road, South Kensington, which is being arranged to take place in the autumn, Mr. R. G. K. Lempfert, M.A., superintendent of statistics, has been appointed to be superintendent of the forecast division, and Mr. E. Gold, M.A., fellow of St. John's College, Cambridge, Schuster reader in dynamical meteorology, has been appointed superintendent of the statistics and library division.

SIR RUBERT BOYCE and his expedition of students from the London School of Tropical Medicine, who have been out to Sierra Leone and Sekondi on behalf of the government, directing the measures necessary for the suppression of the outbreak of yellow fever, are expected to return to Liverpool at the end of the month.

LIEUTENANT SCHIRAZE has left Tokyo with a party of twenty-five Japanese in a small schooner for the Antarctic regions. It is said that he proposes to try to reach the South Pole in advance of Captain Scott.

THE Duke of Mecklenburg has undertaken a second journey across Africa. He will enter West Africa by the Congo-Ubangi route to Lake Chad, and hopes to make his way to the Bahr-el-Ghazal through southern Wadai and other borderlands of the Sudan.

DR. JOHS. SCHMIDT, well known for his biological work in north Atlantic waters, lately started in the *Thor* on a cruise for oceanographical work under the auspices of the Danish government.

ACCORDING to a cablegram from Copenhagen to the Boston *Transcript* Captain Elmar Mikkelsen, with his expedition which sailed June 20, 1909, on the Danish Arctic ship *Alabama* to search for the bodies of the Erichsen Greenland expedition, was wrecked during the winter on the coast of East Greenland. Captain Mikkelsen and the entire party were saved and succeeded in effecting a landing on Shannon Island, off the coast of King William Land. From this point they were recently rescued. The expedition for which Captain Mikkelsen was searching when the *Alabama* was wrecked was that of Mylius Erichsen, who perished in November, 1907, while trying to return from the north coast of Greenland by way of the inland ice. He was accompanied by Lieutenants Haven and Broenlund. Lieutenant Broenlund's body was found in a crevice near a depot of the expedition and was buried there, but the other bodies were not found, owing to the heavy snowfall.

Dr. Charles Fahlberg, associated with Dr. Ira Remsen in the discovery of saccharine and subsequently a manufacturing chemist, died at Bad Nassau, on August 15.

Mr. John Coles, for twenty-three years map curator and instructor in practical astronomy and surveying of the Royal Geographical Society, has died at the age of seventy-seven years.

The death is announced of Dr. R. Klee, head of the veterinary clinic at Jena.

An International Congress on Pathology will be held in Turin in 1911.

The second International Congress of Entomology, will, on the invitation of Professor Poulton, meet at Oxford in 1912.

The third International Congress of Educational Hygiene was opened at Paris on August 2, at the Sorbonne, under the honorary presidency of Professor Landouzy, dean of the Paris College of Medicine, with 1,600 members in attendance.

According to a cablegram to the daily papers the Pan-American Congress, now meeting at Buenos Ayres, has approved the recommendation of the bureau of the Pan-American Union to create a section dealing with commerce, customs duties and statistics, and to prepare a measure for establishing uniform values in international commerce. The congress also approved a recommendation to adopt the metric system, which will be submitted to the next Pan-American Congress. It indorsed the taking of the census in 1920 simultaneously in all the American republics. A convention relating to trade-marks was approved, according to which any trade-mark registered in any of the countries is to be considered as registered in all.

The New York Academy of Medicine has purchased the property at No. 10 West 44th Street and No. 15 West 43d Street. This property has been acquired by the academy for the purpose of either remodelling its present building, which is adjacent to the new property, or erecting a new one.

The following lectures will be given by the Harvey Society on Saturday evenings at the New York Academy of Medicine: October 15, "Die Bedeutung der pathologischen Autopsie," by Dr. H. Chiari, of Strassburg, Germany; November 12, "Unit Characters in Heredity," by Professor W. E. Castle, of Harvard University; December 10, "Certain Clinical Aspects of Dyspituitarism," by Professor Harvey Cushing, of Johns Hopkins University; January 14, a lecture by Professor Arthur R. Cushny, of the University of London; February 4, "The Chemistry of the Proteins," by Dr. Thomas B. Osborne, of the Connecticut Agricultural Experiment Station; February 25, a lecture by Professor Jacques Loeb, of the Rockefeller Institute for Medical Research; March 18, a lecture by Professor H. Gideon Wells, of the University of Chicago.

Nature notes that the useful work of the extension section of the Manchester Microscopical Society is to be continued during the coming winter session. The purpose of this section is to bring scientific knowledge, in a popular form, before societies unable to pay large fees for lectures. In some cases a small fee is charged, but all money thus obtained is devoted to the expenses of the section. The work of lecturing and demonstrating is entirely voluntary and gratuitous on the part of the members of the society. The list of lectures from which secretaries of societies may choose includes some sixty-one subjects and the names of seventeen lecturers.

The British Board of Education has issued a pamphlet containing a translation of the syllabus of instruction in mathematics which forms part of the new courses of study in the Austrian gymnasia. It has been thought desirable to make the translation in view of the fact that the reforms suggested by the Austrian program are similar to those which are being discussed in Great Britain. An additional reason for the publication of the pamphlet is to be found in the interest which has been aroused in the work of the International Commission on Mathematical Teaching established in connection with the International Congress of Mathematicians to be held in Cambridge in 1912.

ACCORDING to foreign journals a Berlin inventor, Mr. Hugo Gantke, has recently designed a simple device for the felling of trees. The trunks are cut by the friction of a steel wire about one millimeter in diameter, which, as demonstrated by practical tests, is able to cut through a tree of about 20 inches (50 cm.) in thickness in six minutes. The wire, which is carried to and fro by an electric motor, is heated by friction on the tree to such an extent as to burn through the timber, the result being a cut which is both smoother and cleaner than that effected by a saw. The wire will work satisfactorily on the thickest trees without the insertion of wedges into the cut, and trees may be cut immediately above or below the ground. In the latter case the stump may be left safely in the soil. The motor which actuates the wire is installed outside of the range affected by the fall of the tree, and when electricity is not already available it can be generated by a transportable power plant, consisting of a 10-horse power petrol motor and dynamo, which are left at the entrance to the forest during the felling operations. By this method large tropical trees up to 10 feet in diameter can be cut and felled by a single operator, a considerable advantage being the absence of any waste in the timber.

UNIVERSITY AND EDUCATIONAL NEWS

GROUND has been broken for the library building at the University of Chicago, which is to serve as a memorial to the late President William Rainey Harper.

GROUND has been broken for the addition to Morse Hall, the chemical laboratory of Cornell University, the cost of which was provided for by Mr. Andrew Carnegie's recent gift of $50,000.

THE cornerstone has been laid of the new building at Columbia University, in which the departments of the faculty of philosophy are to have their rooms.

LIVERPOOL UNIVERSITY benefits under the will of Mr. T. S. Timmis to the extent of £10,000 to endow a cancer research laboratory.

WE learn from the New York *Medical Record* that at the University of Pennsylvania with the opening of the coming fall session an elective course in tropical medicine will be offered under the immediate charge of Dr. Allen J. Smith, in conjunction with Dr. A. C. Abbott, Dr. G. E. de Schweinitz, Dr. William Pepper, Dr. W. H. Hartzell and Dr. H. H. Jacobs. The course will comprise instruction in medical climatology and geography, the hygiene of ships and of the tropics, protozoology, anthropology, helminthology, general medical pathology, diseases of the eye and of the skin, surgical diseases common to the tropics, pathology of tropical diseases, and systematic and clinical tropical medicine.

DR. JOHN HENRY MACCRACKEN has been designated as acting chancellor of New York University, the appointment to take effect on the resignation of his father, Dr. Henry M. MacCracken next month.

DR. L. C. KARPINSKI has been promoted to an assistant professorship of mathematics at the University of Michigan. He will give a course in the history of mathematics.

DR. FRANCIS M. SLACK, director of the bacteriological laboratory of the Boston Health Department, has accepted an instructorship in bacteriology in the Kansas State College.

CHARLES S. WILSON has been promoted to a professorship of pomology at Cornell University.

DR. GOTTLIEB HABERLANDT, professor of botany at Gratz, has been called to Berlin.

DR. A. GILBERT, professor of therapeutics at the Paris College of Medicine, has been appointed professor of clinical medicine to succeed Dr. Dieulafov.

DISCUSSION AND CORRESPONDENCE

SCHMIEDEKNECHT ON THE PARASITIC HYMENOPTERA OF THE FAMILY CHALCIDIDÆ

IN the ninety-seventh fascicle of Wytsman's "Genera Insectorum"[1] Dr. Otto Schmiedeknecht gives a treatment of the hymenopterous

[1] "Genera Insectorum," dirigés par P. Wytsman, Bruxelles, 97me fascicule, Hymenoptera, family Chalcididæ, by Professor Dr. Otto Schmiedeknecht, 550 pages, 8 plates, 1909. (Price, 136 francs, or $27.20.)

family Chalcididæ (= superfamily Chalcidoidea Ashmead) which is of such magnitude and seeming importance that it warrants more or less extended notice in these pages. The volume is twice the size of Ashmead's monumental work on this complex group[2] and its general appearance would indicate that an epoch-making treatment of the superfamily was before us. However, disappointment is sure to follow upon examination of the volume, for its general incompetence and defectiveness are soon revealed, and in fact have already been pointed out by one reviewer. The work certainly is but a huge compilation based mainly on the work of Ashmead, but this is not the reason it loses value as a fitting work of reference to the group. An accurate compilation of the tabular arrangements of the various groups of this complex would be of the greatest importance in serving to advance our knowledge of it, but this would needs be critical and tend to weed out the obvious errors existing in former works. This volume before us, however, is lacking not only in independence of spirit, but also in that nice discrimination which is so much to be desired in works of this kind and it is non-critical and loosely put together. It is hardly exaggerating to say that it is as full of errors nearly as the sum of errors existing in the whole literature of the group, and is especially at fault in the treatment of some of the less known groups where judgment and discrimination are most needed and thus far conspicuous for their absence. As it is highly desirable that the status of this work of Dr. Schmiedeknecht's be made known so that it will not mislead, I select the family Trichogrammidæ for more extended notice, as it is a small group of about fourteen genera badly in need of revision and on that account an excellent specimen of the general defectiveness of the whole work; for if the latter possessed value it should certainly tend to bring order out of the crudeness and confusion at present existing in this family. But see what we have here.

A first glance at the treatment of this family (or subfamily as Schmiedeknecht prefers to style it) shows to a specialist that nearly all essentials of it are paraphrased from the work of Ashmead previously alluded to. A single example is all that is necessary to show this. Thus, immediately preceding the table of the genera of the subfamily Trichogramminæ Ashmead states:

> Subfamily II. Trichogramminæ
>
> This subfamily is easily recognized by peculiarities of the front wings, the pubescence, being arranged in distinct rows or lines, a peculiarity found in no other group, except to a slight extent in some genera in the subfamily Entedoninæ, of the family Eulophinæ.

In the corresponding place Schmiedeknecht gives this:

> 2. Tribus Trichogrammini
>
> Trichogramminæ, Subfamily 2. Ashmead, *Mem. Carnegie Mus.*, Vol. I., p. 360, 1904.
>
> Allgemeine Charaktere.—Die hierher gehörenden Arten sind ausgezeichnet durch die regelmässigen Haarreichen der Flügel. Im beschränkten Masstabe kommt diese Erscheinung nur noch bei einzelnen Entedoninen vor.

These two paragraphs are essentially the same in meaning. And this is so throughout, only Schmiedeknecht adds after the table of genera of each of the two tribes or subfamilies a brief treatment of each of the genera including synonymy, description and catalogue of the species, while Ashmead confined himself entirely to a tabulation of the genera. It is in blindly copying these latter and slavishly following Ashmead in regard to generic diagnoses that our author is most seriously culpable. At the very outset he falls too readily into the probable error of accepting the genus *Oligosita* Haliday as the type of the first division of the group which is perhaps *Brachista* Haliday. In this first division of the group we find exactly the same tabulation of the five genera as given by Ashmead with all of his errors, partly excusable here with him because of the date of the appearance of his work, but

[2] "Classification of the Chalcid Flies or the Superfamily Chalcidoidea, with *etc.*," *Memoirs Carnegie Museum*, Pittsburgh, I. (Publications of the Carnegie Museum, serial No. 21), pp. v–ix, 225–551, pls. XXXI.–XXXIX., 1904.

certainly inexcusable in this later and larger work. In regard to *Asynacta* Foerster and *Brachista* Haliday no attention has been paid to Mayr's descriptions of their type species in 1904, which gave both genera valid standing (formerly without species) and changed our conception of them. This table then is mere copy work. In the brief treatments of the genera following it, the description of *Asynacta* by Arnold Foerster is merely repeated but under *Brachista* Haliday two of Ashmead's species are listed without naming either of them as type; I now know that neither of these species belongs to this genus and that *Eulophus exiguus* Nees is its type as Mayr has designated. *Prestwichia* Lubbock is treated slightly more at length and figured (plate 8, figs. 9 and 10), but the figure of the male is apparently wrongly copied from Willem (1896) and the male antennæ do not show a ring-joint or are but six-jointed.

But in the second division of the group things are much worse. In the table of the genera Ashmead is again followed except in a few minor instances, and an exact copy of his table would have saved commitment of at least one grave error. Thus *Trichogramma* Westwood is made to have an exserted ovipositor in this exceptional attempt at nice discrimination. Otherwise, though the genera are placed in different sequence by shifting sentences, the rest of the tabulation is practically in the same words as given by Ashmead and all of the errors of the latter are repeated. We look in vain for *Ophioneurus* Ratzeburg, for *Calleptiles* Haliday and for *Pterygogramma* Perkins; we are wearied again with the same old mistaken diagnoses of *Poropœa* Foerster and *Trichogramma* Westwood; with the needless enlargement of the characterization of *Chætostricha* Walker (*sic*); with the persistence of *Aprobosca* Westwood, and with the confusion of *Xanthoatomus* Ashmead, a genus without status and a synonym of *Trichogramma* Westwood if such a thing is possible. Hence of the nine genera given in this table four are erroneously diagnosed, two are synonymous with two of the others and one should hardly be accepted—a large percentage of error for such a small number of genera involved; and at least two others were omitted.

But even this is not all. It remains for the brief treatments of the genera included in the table to bring out still others. In spite of definite and positive statements to the contrary witness *Poropœa* being reared from the larva of a beetle; *Ophioneurus* a synonym of that genus and of *Trichogramma; Calleptiles* a synonym of the latter; see *Trichogramma flavum* Ashmead, *T. fraternum* Fitch and *T. orgyiæ* Fitch parading as members of this family; *Ophioneurus signatus* Ratzeburg included within *Trichogramma.* And wonder is indeed excited when we accidentally find the figure of *Trichogramma evanescens* Westwood (by the way perhaps the only valid species of the genus as far as I am able to learn) on plate 8, figure 3, which is obviously concocted from the imagination and is the more striking because it does not even agree with the characters of the genus given in the table of the genera. *Pentarthron minutum* (Riley) is listed three or four times under as many different names and of that genus a number of species are omitted, the most conspicuous of which is (*Oophthora*) *Pentarthron semblidis* Aurivillius. *Lathromeris* lacks its only well-described species, *cicadæ* Howard, and *Centrobia* also lacks one of its two species. But why go farther. We can sum up the treatment of this family very well in percentages of error. Of the fourteen genera described up to the time of the appearance of the work and which are now valid, 21.5 per cent. are omitted entirely, 14.2 per cent. are given as synonyms of other genera and of the genera actually given, a total of 14, 21.5 per cent., are synonyms, the same percentage are referred back to the wrong authorities, 43 per cent. are wrongly diagnosed or described and there is at least 75 per cent. of error in the figures of the two genera illustrated. Of the 44 species described up to the publication of this work as members of the family, Schmiedeknecht omits 30 per cent.; of the 32 species which were then valid, he omits 42 per cent.; 11 per cent. of the 27 species given validity

by him are synonyms and 44 per cent. are wrongly placed as regards genera. Finally, in the whole treatment of the family, covering but seven and a half pages, I am able to count offhand as many as 49 misleading errors, and to offset these not a single feature which in any sense can be called progressive. Hence the obvious conclusion is that we find ourselves no farther advanced, as far as this family is concerned, than formerly. And as a corollary that which is not progressive and helpful in regard to taxonomy is worthless.

It is not fair, however, to condemn the whole work on such restrictive criticism without examining other parts of it, but space of course will not allow more than a few general remarks. Suffice it to say that in all of the other groups we find the same state of affairs as in the Trichogrammidæ and especially a lack of up-to-dateness in regard to new genera and species. Thus even as a bare list of described genera and species the volume would be seriously incomplete and as a contribution to the taxonomy of the superfamily absurd and ludicrous. As a catalogue it would take lower rank than that of de Dalla Torre (1898), which is notorious for its looseness, errors and lack of critical ability, but which, notwithstanding these, possesses much worth as a bibliography of the genera and species. But Schmiedeknecht lacks even in this respect—mainly because of incompleteness.

Of the 83 figures given but 18 of them are colored, in spite of the statement in regard to the 8 colored plates. Many of these figures are copied directly from Ashmead, Howard and Masi, and I find serious differences between these and the originals, but will not particularize here. They may finally take rank with the famous concoctions of Snellen van Vollenhoven; at any rate, it should be pointed out that they are none too trustworthy and by reason of that both obstructive and misleading. Moreover, many are given as original drawings without reference to sources, if such exist, and at least some of these are grotesque and bizarre in the extreme—to wit, the one of *Trichogramma*.

It is a serious thing to have to condemn in its entirety the result of such a prodigious amount of labor, yet it is no more than just and right that others should be warned to keep out of the path of this taxonomic derelict that they, ourselves and the whole future be not imperilled. Truly this volume is both a tragedy and a comedy of errors.

A. Arsène Girault

Urbana, Ill.,
August 2, 1910

The Population of the United States

To the Editor of Science: In the *Popular Science Monthly* for last April, and also in its issue for November, 1900, a formula was given for calculating the population of the United States corresponding to any time between 1790 and 1900.

As the results of each formula agree only approximately with those of the census, I thought it might be of some interest to present a formula that should agree exactly. Such a formula is the following:

$$P = A + at + bt^2 + ct^3 + dt^4 + et^5 + ft^6,$$

in which P denotes the population, in millions, t the time expressed in decades and estimated from 1790; while

$$A = +3.9,\ a = +0.523333,\ b = +1.603889,$$
$$c = -1.020833,\ d = +0.343056,$$
$$e = -0.0525,\ f = +0.00305555.$$

The formula holds good from 1790 to 1850, but from 1850 to 1910 the coefficients have the following values:

$$A = +23.2,\ a = +18.303333,\ b = -19.481111,$$
$$c = +12.470833,\ d = -3.544444,$$
$$e = +0.475834,\ f = -0.0244444,$$

and the origin of t is at 1850.

Any series of observations which depend on a single variable may be represented by a formula of this kind, and a table has been prepared by means of which the values of the coefficients, a, b, c, etc., can be easily and expeditiously calculated. By the aid of this table a formula could be developed which would give the exact results of the census from 1790 to 1910, and without any change in the values of the coefficients.

But the formula would contain nearly twice as many terms as the one here submitted, and there would be other disadvantages.

An empirical formula is valuable for purposes of interpolation; but it is utterly unreliable when used for making predictions, or extrapolations.

The following table gives a synopsis of the results of the United States Census as to population, and it is given mainly for the sake of calling attention to the last column, which affords a basis for making deductions in regard to the future growth of population.

Growth of Population

Year	Population by Census (Millions)	Population by Formula	Percentage of Increase
1790	3.9	3.9	
1800	5.3	5.3	36
1810	7.2	7.2	36
1820	9.6	9.6	33
1830	12.9	12.9	34
1840	17.1	17.1	33
1850	23.2	23.2	36
1860	31.4	31.4	35
1870	38.6	38.6	23
1880	50.2	50.2	30
1890	62.6	62.6	25
1900	76.3	76.3	22
1910	91.4[1]	91.4	20

The last column shows that the relative increase was practically constant during the first seventy years, commenced to decline at the end of that period and has continued to do so ever since; the decline during the last fifty years having amounted to 15 per cent. The decrease is likely to be more rapid in the future than it has been in the past, since the conditions for an increase of population are not as favorable now as they were in 1860, when there was so much unoccupied land. It seems evident, therefore, that unless agricultural methods are improved and the soil made more productive, or unless people become more economical, the population of the country is likely to reach a stationary state in fifty years or less.

FRANK GILMAN

BOSTON, MASS.,
July 25, 1910

[1] Preliminary estimate.

QUOTATIONS

SALARIES OF PROFESSORS

THE question of salaries for professors is one which will always be one of the questions most alive at Cornell. The Carnegie fund for retiring aged professors has been of great help in retaining good men up to the time of retirement, but at the present time, when incomes of men in various professions and trades have advanced so rapidly, the salaries of professors have not advanced with the increased cost of living. The result is that much of the teaching has to be done by young men on small salaries who are continually looking in a natural way for opportunities to broaden their incomes and fields of usefulness. It is probable that the original intention of furthering investigation, by retiring professors at a certain time, will be found to miss this particular mark, because research work represents a type of mind quite as much as it represents opportunity. Men who have not done research work in advance of retirement are not apt to do any after retirement. Our policy of selecting noted professors from different parts of the world, as Johns Hopkins has done, accounts for a part of our rapid progress, but we have need for large incomes which will attract the men who attract students as they do at some of the older institutions of learning in other countries. We need to be able to offer salaries of at least ten thousand dollars per year for men who have proven their ability to command such salaries, no matter whether such men have developed at Ithaca, or at other institutions of learning. In making up a teaching staff of young men who are simply in line for promotion on the ground of faithful work, there is always a menace to the character of the teaching, because propinquity is one of the great powers in this world, and if it is more convenient to fill positions with men who are near at hand, and who will accept such positions on small salary, the tendency is always toward filling the teaching staff with a cumbersome number of men of merit without genius, but it is the men of genius whose names are synonymous with the names of cer-

tain universities.—From the report of Trustee Robert T. Morris, printed in the Cornell *Alumni News.*

SCIENTIFIC BOOKS

Water: Its Origin and Use. By William Coles-Finch, Resident Engineer to the Brompton, Chatham, Gillingham and Rochester Water Company, Kent, England. New York, D. Van Nostrand Co., Publishers. 1909. Pp. xxi + 483. $5.

This book is not a scientific record, but written from the standpoint of an engineer professionally interested in the finding and distribution of water. Accompanying the text are numerous illustrations of mountain and glacier scenery from the original pictures of Mrs. Aubrey Le Blond (Mrs. Main), and also photographs and diagrams illustrating the engineering work of the author. Mr. Coles-Finch makes no claim to originality, but he has put together in an interesting and readable form a great deal of information on a very wide subject. A copious index adds to the value of the work.

The book opens with a discussion of solar heat, which is really the cause of water in all its forms, and the atmosphere, "without which nothing could live, nothing could burn, nothing could grow; without which no sound could be heard, and there could be no rain."

The average annual rainfall of the globe is computed to be 33 inches. In Assam from 600 to 805 inches have been recorded, while in the Sahara desert, part of Arabia, the desert of Gobi, and portions of Mexico, Chili and Peru it has seldom been known to rain. It seems to be the fact that the atmosphere of the earth is growing drier. The glaciers are retreating, the Caspian Sea and many other lakes are growing smaller, and the great deserts seem to be extending. Some of the richest countries on earth have seen their fertility decreasing, mainly owing to the ruthless destruction of their forests.

> Ruined forests mean flooded rivers, periodic droughts, eroded soil and dried-up springs. . . . Many bodies having control of large tracts of land, such as water boards, are planting their catchment areas with trees with advantage and profit; for it is found that the presence of trees adds to the retention of water falling as rain as well as by radiation and cooling the adjacent atmosphere, causing condensation and rain; it prevents floods, regulates and purifies the supply, for water from wooded areas is generally purer than that falling on bare land.

Three chapters are given to the story of snow, ice and glaciers. The different forms of ice are described, from the silver thaw or "glazed frost," which is "neither hail, hoarfrost nor snow, but rain, each drop of which solidifies as it touches any solid body," to the vast fields of ice formed in polar regions, rising to a height of 3,000 feet or more, and the glaciers, formed by the congelation and compression of the mountain snow, and which in their movement over the northern portions of Europe, Asia and America during the glacial period, mixed together the elements of different districts, disintegrated them, carried them over and deposited them on the hard chalk, rock and other foundations, covering them with rich soil well adapted for the growth of vegetation.

Having followed atmospheric water through the process of evaporation and the various forms in which it reaches the earth, the next five chapters trace its passage through the soil and rocks on its way back to the sea. On their way these streams carry material from one location to another, slowly raising new continents, and gradually but surely changing the configuration of the earth's surface by the formation of bars, estuaries, lagoon and sandbanks.

But the work of rain, rivers and waterfalls is as nothing compared with that of the sea.

> The billows of the ocean agitate the loose material on the shore, wearing away the coast with endless repetitions of this act of power and imparted force; the solid portion of our earth, thus sapped to its foundations, is carried away into the deep, and sunk again at the bottom of the sea, whence it had originated, and from which, sooner or later, it will again make its appearance. (Dr. Hutton.)

The last chapters of the book are devoted to a discussion of the methods by which water is obtained and stored for domestic and mechan-

ical purposes, and for irrigation in regions where long droughts are periodically experienced. In many such localities, by means of "storing, diverting and distributing the flood water of a river or rivers," the land has been reclaimed from the desert and made capable of supporting a large and prosperous population.

F. P. GULLIVER

Die Palaeobotanische Literatur-Bibliographische Übersicht über die Arbeiten aus dem Gebiete der Palaeobotanik. Von W. J. JONGMANS. Erster Band: Die Erscheinungen des Jahres 1908.

Gustav Fischer, of Jena, has just issued the first volume of a proposed annual bibliography and index of contributions to paleobotany compiled by W. J. Jongmans, of the Royal Herbarium at Leiden.

In considering a work of this sort one naturally surveys the field that it aims to cover and what agencies already attempt to cover this field. General paleobotanical reviews published periodically were commenced by the late Marquis Saporta and ably continued after his death by Professor Zeiller in the *Revue Générale de Botanique.* These have always been valuable summaries of paleobotanical progress. The *Geologisches Centralblatt* attempts to cover paleobotanical literature but the work is so poorly done and incomplete that it is of little value. The *Botanisches Centralblatt* covers the field of paleobotany much more thoroughly, but there are so many contributors that the reviews lack balance, an insignificant paper often occupying more space than one of importance. The Royal Society catalogue attempts to cover the paleobotanical field in much the same manner as the work under discussion, the chief criticism in the case of the former being the slowness of publication, the very serious number of omissions and the over-elaborated system of arrangement and citation.

In addition to these general bibliographies the Torrey Botanical Club publishes each month a briefly annotated bibliography of contributions to American botany, including paleobotany, and the United States Geological Survey publishes at intervals bibliographies by years of contributions to American geology and paleontology also covering paleobotany and indexed systematically, but neither of these in so far as they refer to fossil plants are as well done as the work before us, and the limited field they cover make them far less valuable, particularly since it is not difficult to keep up with what is coming out in one's own country.

It would appear then that there is a distinct opportunity for an annual publication of just the kind that Jongmans has given us.

The first part contains an alphabetical catalogue of the papers which have appeared in 1908, arranged by authors, and in a rather careful examination no omissions have been discovered, although it is too much to expect that there are none such. A minor defect noticed is that the same work, as for example Engler's Jahrbuch is cited in several different ways. The second part, also arranged alphabetically, is a systematic list of species, genera and other botanical groups described or merely referred to by the various authors in their comparative discussions, including also the living plants with which the fossil plants are compared, and the various geological horizons. A chance quotation will show the character and scope of this part: "*Alethopteris lonchita* Schl.—Karbon, North Derbyshire—Horwood (2), p. 6, Pl. A, Fig. 1." Synonyms are given a place and their equivalence as determined by the various authors are indicated, so that the work is a complete compendium of all that is being done along paleobotanical lines throughout the world, and the reader can get a very tolerable, even if skeletal, idea of the character and contents of every paper published, something that it is not always easy to do from the titles of papers.

If the high standard of this first volume is continued and subsequent years appear more promptly the work will prove well nigh indispensable to every student who wishes to keep informed of the rapidly increasing flood of paleobotanical investigation. The author and

the publisher are both to be congratulated upon the real excellence of their work.

Edward W. Berry
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BOTANICAL NOTES

AN EXPERIENCE AND A SUGGESTION

It was the writer's good fortune to be asked to take part in the work of the first week of the fourth session of the Graduate School of Agriculture held at the Iowa State College, Ames, Iowa, during July.

Having had no previous experience with this national school, which meets biennially, the writer was not prepared to find, as he did, the work of such high grade. There were lectures on plant breeding, plant physiology, the soil scientifically considered, the scientific basis of "hardiness" of plants, the scientific basis of animal husbandry, agricultural economics, the bacteriology of dairying, the scientific breeding of poultry, irrigation, etc. In addition to the lectures, which were usually scheduled for the forenoon and the early part of the afternoon, there were held in each subject two-hour seminars in which the topics which had been presented by the lecturers were freely discussed by the listeners, and the lecturer was asked to present more in detail the matter presented in a general way in the lecture. This proved to be very helpful to lecturers and audience.

The week's experience of the writer leads him to the conclusion that in the Graduate School of Agriculture, as now managed, the scientific men of the country have an organization of very great importance. The lectures and the discussions were of such a high order as would have taxed the knowledge of any of the larger scientific bodies which meet annually in this country. The writer suggests that in the meetings of the American Association for the Advancement of Science something of the plan carried out in this School of Agriculture should be adopted. One who has attended the meetings of the American Association for many years realizes that much is lost by the fact that usually there is no unity in the program for any day; occasionally in the later years we have had a symposium on one subject, and it has been the general feeling that the symposia have been the most successful parts of the programs. The writer suggests that there might well be several subjects (in botany, for example) which should receive especial attention in the week given to the presentation of papers. Thus there might be at a stated hour each day a lecture by a master on, say, the subject of cytology, and another lecture each day at a stated hour, on morphology, while another might be given on physiology, and possibly more, and then for each evening in some convenient room, a seminar meeting could be held on one of the subjects presented by the lecturers.

The writer feels that his experience at Ames, where the air was full of the most modern science, warrants him in suggesting that the men who constitute the membership of the scientific societies have something to learn from this Graduate School of Agriculture.

THE ACTION OF THE BRUSSELS CONGRESS

From the reports which have reached us regarding the action taken by the International Botanical Congress at Brussels it is evident that while gratifying progress has been made in the attempt to reduce the nomenclature of botany to uniformity much still remains to be done. However, we must not overlook the fact that to have come to some agreement, and to have formulated rules covering so many points is itself a triumph for those who have insisted upon the need of rules. It is not so very long ago that certain botanists were "a law unto themselves," to the disgust and indignation of others who were the advocates of the application of a general law. That was a condition of anarchy, which happily we are now delivered from. The Vienna Congress, and later the Brussels Congress, have emphasized the fact that botanists the world over are willing to come to an agreement in this matter of nomenclature. And this is a great gain. Once this is accomplished it will be only a question of time as to the enactment of the best rules. To be will-

ing to come together at all is the first requisite, and when once that is attained the rest will follow as a matter of course.

Now all of this does not imply that the writer is satisfied with all that was done in Vienna and Brussels. Far from it. The writer's feelings are very much like those he experiences where he contemplates the actions of, say, the last session of congress. He fully believes in the making of laws by legislative action, but he does not approve of all that legislative bodies do. Yet while he withholds his approval he recognizes the binding force of these same disapproved laws. So it is and must be with these rules made by the botanical congresses. Many of them are good, in fact the great majority of them meet with the approval of all botanists. Some of them are no doubt unwise, but that is to be expected from human legislation. Thus, in the opinion of the writer, the Brussels Congress erred in designating so many beginning dates, but even this is to be preferred to having *no agreement whatever*. It is really quite absurd in the Algæ, for example, to have beginning dates all the way from 1753 to 1900! Yet that is not so absurd as having no agreement at all as to beginning dates.

Then the adoption of so many lists of *nomina conservanda* looks very much like an acknowledgment of the inability of the leaders to successfully lead the mass of delegates. These lists are so many exceptions to the rules, and so far are pitiful exhibitions of weakness on the part of the lawmakers. And yet the writer remembers that in his old English grammar there were similar troublesome exceptions to the precisely stated rules.

What shall we do with these rules is a question which comes to every thinking botanist, and some in their disappointment and chagrin are boldly saying that they will ignore them. This course does not seem wise to the writer, who confesses to a very strong dislike of some of the rules. So much has been accomplished by the agreement to refer nomenclatural matters to international congresses, that we must not overturn it all because we did not get everything we asked. Let us regard these rules as valid, but retain our right to "cry aloud" our disapproval. Had the writer been in Brussels he would have voted against every one of the *nomina conservanda*, but when outvoted he would have accepted (with a wry face, perhaps) the dictum of the congress, and he would have given notice—as indeed he does now—of his intention to work to secure the reduction and final abolition of all such lists. The duty of every botanist appears to be plainly to accept the rules as given us, but to seek to convert enough other botanists to our way of thinking so that eventually we shall be in the majority, while those who hold contrary opinions shall be in the minority.

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A NOTE ON TRAUBE'S THEORY OF OSMOSIS AND "ATTRACTION-PRESSURE"

PROFESSOR ISIDOR TRAUBE, of the Technische Hochschule at Charlottenburg, is the author of a series of interesting investigations[1] on the relation of the phenomena of surface-tension to osmosis, digestion, narcosis, hæmolysis and serodiagnosis, the most significant practical outcome of which is the so-called "meiostagmin[2] (little drop) reaction," a blood serum test recently devised by Professor Ascoli, of Pavia, to confirm the diagnosis of malignant tumors, syphilis, typhoid and other diseases. Experiment has show that there is some measurable variation in the surface-tension of such body-fluids as the urine, gastric juice, milk, blood, under different conditions, and it seems likely that this physical constant may play some part in the diagnostic procedure of the future. A striking example of this is the Matthew Hay test for biliary acids in the urine.[3] If flowers of sulphur be sprinkled on

[1] *Biochem. Ztschr.*, Berlin, 1908, X., 371; 1909, XVI., 183; 1910, XXIV., 323, 341.

[2] From μείων, little, and στάζω, drop.

[3] Printed as a private communication by Professor Hay in the second edition of Landois and Stirling's "Physiology," London, 1886, p. 381; Philadelphia, 1886, p. 294. Spivak claims the test is delicate to the limit of one part of glycocholic or taurocholic acid in 120,000 parts of water (*J. Am. Med. Ass.*, Chicago, 1902, XXXIX., 630).

a quart of water or of urine free from bile, the high surface-tension of the latter fluids will support the sulphur so that it will float for weeks. Directly a drop of bile is added to either fluid, the surface-tension is lowered, and the pull of gravity overcoming the push of surface-tension, the sulphur sinks to the bottom as if *in vacuo*. Professor Ascoli's test, which is confessedly derived from Traube's researches, is based upon the experimental fact that when the antibodies of a disease and its corresponding antigens are brought together there is a noticeable lowering of the surface-tension. The tension in this case is not measured by the ordinary method (height of a given fluid in a capillary tube), but after the fashion devised by Traube, which consists in enumeration of droplets at constant temperature in unit time from a special pipette of Traube's invention, the "stalagmometer." Taking distilled water as the standard, the greater the number of drops from the stalagmometer per minute (at fixed temperature) the lower the surface-tension and *vice versa*. If the diluted blood serum of a cancer or typhoid patient is exposed to the action of the corresponding antigen for two hours in an incubator at 37°, the surface-tension will be found to be sensibly lowered by actual measurement. This mode of diagnosis, the details of which will be found in Professor Ascoli's papers,[4] is now on trial in Italy and Germany and some of the results are forthcoming.

Ascoli found that 93 out of 100 cases of carcinoma and sarcoma gave a positive reaction by the meiostagmin test; the 7 negative cases gave consistently negative data with other antigens. In 102 assorted cases of other different diseases the test was negative or unsatisfactory.

Michele and Catoretti[5] obtained a positive diagnosis in 28 cases of carcinoma and sarcoma. Tedesko[6] was equally successful in 28 out of 29 cases of carcinoma. S. d'Este[7] got positive results in 12 cases of malignant tumors, but negative data in 10 benign tumors; and he concludes from his trials with tuberculosis that, in comparison with reactions like the von Pirquet test, the Ascoli reaction is reliable only in well-developed tubercular cases, not in obscure or latent lesions. Izar[8] got positive data in 34 out of 35 cases of phthisis with ascertained bacilli, and in 5 other cases in which phthisis was diagnosed but the bacillus not found, the meiostagmin test was equally positive. In addition, Izar obtained positive results in 10 cases of hydatids and 6 cases of hook-worm infection; on the other hand, Weinberg and Jonesco's[9] results in 10 cases of hydatids were all negative. In 90 cases of ascertained syphilis, Izar and Usuelli[10] found that 67 were positive both for the Ascoli and Wassermann reactions. Of the remaining 33 cases, 9 were negative for the Ascoli test of which 3 were positive for the Wassermann; 7 were negative for the Wassermann, 5 of which were positive for the Ascoli; in 3 cases both tests were doubtful, in 4 others absolutely negative. Of 18 doubtful cases of syphilis, 6 were positive for the Wassermann test, and negative for the Ascoli; 8 were positive for the Ascoli and negative for the Wassermann; 4 were negative for both. In 104 cases of other different diseases investigated by Izar and Usuelli, it was found that the Ascoli reaction was negative in all except a single case of erythema nodosum. The meiostagmin reaction would appear, then, to be a reliable corroborative test in cases of carcinoma and sarcoma and may have some value in typhoid and syphilis, but it is still *sub judice* and its merits may be left to the clinical and surgical bacteriologist. The object of this communication is to draw attention to some aspects of the theory upon which the test is based.

[4] *München. med. Wochenschr.*, 1910, LXII., pp. 62, 403, 1170.

[5] *Ibid.*, 1122.

[6] *Wien. med. Wochenschr.*, 1910, No. 26, p. 1514.

[7] *Berl. klin. Wochenschr.*, 1910, No. 19, p. 879.

[8] *München. med. Wochenschr.*, 1910, LVII., p. 842.

[9] *Compt. rend. Soc. de biol.*, Paris, 1910, pp. 1015–1017.

[10] *Ztschr. f. Immunitätsforsch.*, Jena, 1910, VI., pp. 101–112.

In 1894[11] Professor Traube announced his conviction that the direction and velocity of the osmotic current (and consequently the driving force in osmosis) is due to a difference in surface-tension between the two fluids on either side of the colloidal or semi-permeable membrane. He bases this conclusion upon some years of experimental investigation, to which he was originally led by a consideration of Overton's work on plasmolysis and absorption in vegetable cells. Overton found that all substances whose watery solutions can penetrate the walls of plant cells lower the surface-tension of the solvent water, while those which can not penetrate the cell-walls raise the tension of the water in which they are dissolved. Traube's investigations of capillary constants tallying in every particular with Overton's plasmolytic data, the natural inference was that there is an equation between velocity of osmotic diffusion and degree of surface-tension. In Traube's theory, the driving force in osmosis is a superficial (or interfacial) pressure (*Oberflächendruck*) obtained by subtracting the surface-tension of one fluid from the tension of the fluid into which it diffuses. His view is thus entirely at variance with the theory of van't Hoff and his followers who contend that the motor power in osmosis is the kinetic energy of the dissolved molecules, the osmotic pressure being due to the impact of these molecules against the walls of the semi-permeable membrane, and obeying the laws governing pressure relations in gases. Traube compares the two fluids on either side the semi-permeable membrane with two parallel chains of men and women holding hands and facing each other. Suppose each man to loosen his hold and grasp the hands of the woman opposite, and a "tug of war" to ensue: the physically weaker women will be pulled towards the stronger men. So, in osmosis, the fluid having the lower surface-tension must inevitably be drawn towards that having the higher.

In 1898[12] Professor Traube proceeded to rectify and clarify some of his views in regard to the selective action which the semi-permeable membrane may acquire through deposition of lipoid solvents upon it, and he was further led to fortify his theory of osmosis in another way. To quote his own language: "I attribute this clarification of my views to the fact that my attention was called to an important theorem of which I had not previously been aware, the thermodynamic demonstration of which is originally due to the great mathematical physicist, Willard Gibbs. . . . The theorem of Gibbs amounts virtually to this, that all substances which lower the surface-tension of a solvent tend to collect at the surface of discontinuity." Traube then restates the Gibbs theorem in a form more practicable for physiological chemists as follows: "The more a substance increases or decreases the surface-tension of the pure solvent, the larger or smaller is its '*Haftdruck*'"—meaning by '*Haftdruck*' the "attraction-pressure" with which the solute (dissolved substance) tends to remain in solution, a quantity which Professor Traube identifies with the "cohesion-constant" of van der Waals. The attraction pressure Traube holds to be the pressure corresponding to the (chemical) union of the solute and the solvent. It is thus the "*intensity factor*" of the solution-energy, as opposed to the number of dissolved molecules, which is its "capacity factor."[13]

Now the theory of osmosis which Traube so honestly and conscientiously traces back to the Gibbs theory of surface-tension affords at the same time an interesting confirmation of the view of osmosis propounded by Gibbs himself. According to Gibbs,[14] the force that drives the fluid through the semi-permeable membrane is not an initial "osmotic pressure," but either a difference in temperature or a difference in chemical potentiality between the two fluids bathing opposite sides of the membrane. If the fluids be identical in composition but have different tem-

[11] *Pflüger's Arch. f. d. ges. Physiol.*, Bonn, 1904, CV., 541, 559.

[12] *Pflüger's Arch.*, 1908, CXXIII., 419–432.

[13] Traube, *J. Phys. Chem.*, Ithaca, 1910, XIV., 452–470, 471–475. Also, *Pflüger's Arch.*, 1910, CXXXII., 511–538.

[14] *Tr. Connect. Acad. Arts and Sc.*, New Haven, 1874–8, III., 138–140.

peratures, an osmotic current will obviously be set up in order to equalize the temperature. If the fluids have the same temperature but are of different chemical composition, the osmotic current, if any, will be the resultant of forces flowing from higher to lower levels of chemical potency or potential energy. Or as Van Laar and other followers of Gibbs have interpreted it, the substances having the higher chemical potentials will move towards those having the lower. "Even when the diaphragm is permeable to all components without restriction," Gibbs insists, "equality of pressure is not always necessary for osmotic equilibrium." These conditions are, mathematically, that $t' = t''$ and $\mu' = \mu''$ . . . where t', t'' and μ', μ'' are the temperatures and chemical potentials of the substances that can pass through the semi-permeable diaphragm. Now the Gibbsian potential μ was interpreted by Clerk Maxwell as the intensity with which a given component substance tends to expel itself from the compound containing it, and is equal mathematically to the surface energy (marginal available energy) of the component per unit mass at fixed temperature.[15] Professor Traube's "attraction-pressure" would appear to be just the logical opposite of this concept, viz., the tendency of the given component to "stay put." But for chemical equilibrium these "intensities" must necessarily balance each other; in other words, the "Haftdruck" is conceivably the Gibbs potential μ with reversed sign $(-\mu)$. The chemical potential of Gibbs is identical with Lewis's more recent concept of "fugacity" or "escaping tendency," which the latter defines[16] as "the tendency of every molecular species to escape from the phase in which it is"; the "attraction-pressure" of Traube is apparently a static expression of the "chemical affinity" or "chemical attraction" of other writers. These differences in fundamental conceptions may serve to illuminate some obscure features of the gigantic controversy which has been waged of late years in regard to osmosis and the theory of solution.

Up to 1887, as Professor Louis Kahlenberg has recently called to mind,[17] all theories of osmosis and solution were purely chemical. After that date, under the sway of the van't Hoff-Arrhenius school they became purely physical. But the van't Hoff theory depends for its physical proof upon the assumption that molecules, and ions exist as such, while its mathematical proof is bound up with the notion that liquid substances act like gases,[18] although a moment's common-sense reflection will convince any one that they do not. This theory which Lothar Meyer, Lord Kelvin and Fitzgerald combated upon its first appearance, and which chemists like Kahlenberg, Armstrong, van Laar, Mendelejeff and Raoult have latterly opposed with such striking ability, owes most of its acceptance to the personal influence and brilliant partizanship of Professors Ostwald[19] and Arrhenius; but, as Pro-

[15] See Gibbs, *Tr. Connect. Acad.*, III., 150: "In the case of a body of invariable composition, the potential for the single component is equal to the value of ζ (available energy at constant atmospheric pressure) for one unit of the body, etc."

[16] *Proc. Am. Acad. Arts and Sc.*, 1901–2, XXXVII., 54. Lewis introduces "fugacity" as a sort of generic variable to include all such concepts as thermodynamic potentials, vapor-pressure, solubility, etc.

[17] Science, 1910, No. 785, 41–52.

[18] What van't Hoff set out to prove was that the kinetic energy of a molecule in the dissolved state is equal to that of the same molecule in a gas occupying the same volume as the given liquid solution, and he maintains that his thermodynamic demonstration is true whatever the mechanism of osmosis and whether the rôle of the semi-permeable membrane be "selective" or otherwise. Since van't Hoff took this stand in 1887, it has become, as Kahlenberg insists, "a favorite dodge of the thermodynamicists to claim that they are not concerned with the mechanism of osmosis," thus evading the crucial point at issue in favor of computations tending to prove a theorem based upon assumptions about molecules and admittedly true only of ideally diluted solutions (see Kahlenberg, *J. Phys. Chem.*, 1909, XIII., 97).

[19] To show how far such propagandism may be carried, recent reviews of Ostwald's book on the evolution of chemistry ("Der Werdegang einer Wissenschaft") comment upon the fact that he has suppressed all reference to Graham, to whom chemists are indebted for many of their funda-

fessor Traube contends, it has proved absolutely sterile and unprofitable for advancement of knowledge. Applied to the investigation of concentrated or non-aqueous solutions,[20] the van't Hoff shibboleth $pv = rt$ has become a sort of scientific plaything, having yielded hardly a single new fact of importance. The return to a more chemical theory of solutions signalized in Professor Kahlenberg's Boston address[21] was, therefore, inevitable and few will disagree with his opinion that "the efforts to gain insight into the different solutions that confront us must be chiefly experimental rather than mathematical." It was a favorite aphorism of Professor Huxley's that pages of mathematical formulæ will yield only chaff if applied to loose or erroneous data and Sylvester, who believed that mathematics is an experimental and inductive science, once stated that he had published a number of theorems which, when tested arithmetically, proved to be untrue; but if a purely chemical theory of solutions is to make much headway and not be involved in further obscurity, it seems desirable that such indefinite, imaginative concepts as "chemical attraction," "chemical affinity" or "chemical potentiality" be more clearly defined or differentiated.

To illustrate the difficulty by returning to Professor Traube's analogy, suppose chemical substances to be represented by a number of men and women of varying degrees of strength of character and "attractiveness," and suppose the marital combinations or what Goethe called the "elective affinities" between these men and women to be determind by certain mysterious "laws." If a man strong in character should mate with a woman, weaker but otherwise "attractive," or *vice versa,* one set of observers might affirm that the union was due to the man's superior potentiality or masculinity, others might maintain that the real strength in the combination or "affinity" lay in the woman's "attractiveness"; or *vice versa.* Curiously enough, these anthropomorphisms, which seem so plausible and fascinating in Goethe's novel, are daily and hourly employed to explain the facts of chemical combination.

The merit of Willard Gibbs's theory of physical chemistry lies in the fact that it does not rest upon any fanciful anthropomorphisms nor upon any theory (molecular or other) as to the

mental notions about osmotic and colloidal phenomena. No one will impute this error of omission to either carelessness or insincerity; in all probability, Professor Oswald's faith in the van't Hoff formula is such that he sincerely believes that the name of Graham is of no further importance in the history of chemistry. Yet no modern chemist or physicist has got beyond Graham's simple conception of osmosis as "the conversion of chemical affinity into mechanical power." (*Phil. Tr.*, London, 1854, 227.)

[20] Professor Kahlenberg relates that while working in the inspiring atmosphere of Ostwald's laboratory in 1895, he asked the director why the electrical conductivity of non-aqueous solutions was not studied there, eliciting the genial reply: "Die nicht-wässerigen Lösungen leiten ja nicht!" (*J. Phys. Chem.*, 1901, V., 341.) Professor Traube likens the partizan of ionic dissociation to an electrochemist who believes that the electrical energy of a current depends more upon its intensity than its electromotive force. Then he points out that Arrhenius assumes the ions in a dilute solution to be at once electrostatically bound but chemically unbound, although Faraday and Helmholtz held the electrostatic and chemical forces of the ions to be one and the same. (*J. Phys. Chem.*, 1910, XIV., 475.)

[21] Professor Kahlenberg maintains that a solution is not a physical mixture but a chemical composition, differing from other chemical compounds in degree but not in kind. It would seem probable, from this argument, that the "gas-analogy" of the van't Hoff-Arrhenius school confuses the act of solution with the act of *dilution*, which at once reduces the problem to the query: Is the act of dilution (the solution of a watery solution in water) the physical analogue of a mixture of gases? Kahlenberg's view of osmosis is contained in the following lucid statement: "The motive power in osmotic processes lies in the specific attractions or affinities between the liquids used,

and also those between the latter and the septum employed. These attractions or affinities have also at times been termed the potential energy of solution, etc.; they are to the mind of the writer essentially the same as what is termed chemical affinity." (*J. Phys. Chem.*, 1906, X., 208.)

ultimate constitution of matter,[2] but is firmly grounded upon the cardinal principles of conservation, dissipation and transformation of energy, which have not been invalidated by any single fact of recent science. In the Yale professor's exhaustive memoir on chemical equilibrium we see the huge fabric of theoretical chemistry developed like a plant out of these single germs, and not one of its seven hundred equations and formulæ has been discredited or disproved by any result of laboratory investigation. Rather do the physical chemists tend more and more to look up to Gibbs as the theoretical founder of their science, and each year has brought forth some new and interesting application of his ideas, from the card-diagram by which the engineer tests the heat wastes of an engine up to industries so various as the manufacture and repair of steel rails, the chemical investigation of soils and their constituents, the artificial manufacture of rocks and precious stones, the liquefaction of obstinate gases like helium, the testing of such "materials of engineering" as Portland cement, the complete revision of analytical chemistry and the most recent aspects of colloidal chemistry—the capillary and dispersoid chemistries and the interfacial chemistry (*Oberflächenchemie*) of the Germans. The Gibbs theory of osmosis, in particular, is strong above all others in the simplicity of its ideas, and in stating his theorems that the osmotic pressure and the surface-tension are both of them functions of the temperature and the chemical potentials of the component substances involved, we know that the "chemical potential" of a substance is no mere fanciful concept, but means the measurable surface energy of the substance (per unit mass) that is available for mechanical effect. A substance of higher chemical potentiality than another would therefore be one having a greater surface energy, that is, a greater immediate *intensity* (as distinguished from capacity) for distributing, diffusing or dissipating energy, *i. e.*, for doing work, and such a substance would obviously have a greater power for chemical combination over substances more inert. In connection with the application of his ideas to experimental pathology by Traube and Ascoli, these theorems of a physicist, whom Boltzmann declared the greatest synthetic mathematician since Newton, should have some interest.

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[2] Possibly one reason why some chemists have neglected Gibbs's theory of osmosis is that many years after he published it, he seems to have fallen under the sway of the van't Hoff hypothesis and in 1896 published an independent proof of the latter based upon the assumption that the molecules of the solute "should not be broken up in solution nor united to one another in more complex molecules." (*Nature*, LV., 461.) This *tour de force*, while completely at variance with the chemical hypothesis of the formation of hydrates in solution, does not in the least impair the value of Gibbs's earlier and more comprehensive argument of 1874.

SPECIAL ARTICLES

THE LUMINOSITY OF COMETS

The return of Halley's Comet has given rise to increased interest in these "heavenly wanderers," and it has also induced much speculation as to the cause of their luminosity.

It is known from the revelations of the spectroscope that comets are composed of matter in its various phases. Some comets may be wholly gaseous during most of their journey, but when remote from the sun the gas condenses to liquid and finally freezes, owing to the low temperature of interstellar space.

The spectra of comets change as they pass to and from the sun. Near the sun they show the Fraunhofer lines indicating that the light from them is reflected sunlight. At other times, when nearer the sun, they show emission spectra of sodium, calcium, iron, etc., indicating that the sun's heat has volatilized these metals; but during most of the comet's journey the only light emitted is similar to that produced by the ionization of gases through electric influence.

The nucleus of a comet may be solid, liquid or even more or less dense gas. In any case the nucleus is surrounded by a gaseous envelope which is more attenuated the greater

the distance from the center of gravity of the comet, like the atmosphere surrounding the earth; but much more rarefied than the earth's atmosphere, since the mass of the comet is much less than that of the earth. The composition of the gaseous envelope of different comets varies. Cyanogen, hydrocarbons and other gases have been detected in the few comets which have been examined by modern spectrographs.

A comet, then, is a globule of gas, with a more or less dense nucleus, floating in almost vacuous space. During the greater part of its journey it is between the sun and one or more planets.

It is well known that there are electric discharges constantly passing between the sun and the planets. The difference in potential between the earth and the sun is a billion volts. The sun is positive, while the earth and the other planets are negative. Thus we have in our solar system one large anode and numerous cathodes—great and small. The electrons are expelled in steady streams from the earth and other planets toward the sun with ever-increasing speed, acquiring almost the velocity of light as they near the end of their journey. According to Arrhenius, the sun drains the space surrounding it of all of its free electrons as far out as one sixtieth of the distance of the nearest fixed star. The nearest fixed star (α Centauri) is 4.35 light-years distant from the sun, and one sixtieth of this distance would be about 152 times the mean distance of Neptune from the sun. In the meantime the sun is expelling positively charged atoms—ions—carrying the same amount of charge as the electrons, but of opposite character. These ions are about one thousand times as heavy as the electrons and having the same amount of electric charge, they move at about one thousandth the velocity, which, however, is still prodigious. The velocities of groups of positive ions have been measured by Wein, who found one group to have one one-thousandth the velocity of electrons, another one two-thousandth, and still another one one-millionth of their velocity.

When the electrons approach the sun they discharge the ions and cause condensation of the gases. These condensed particles are then exposed to the radiation of the sun, which, according to Maxwell and Bartoli, is sufficient to balance the weight of a drop 8×10^{-6} cm. in radius, having the density and capacity of water, *i. e.*, a radiation pressure of about 2.5 times solar gravity. Therefore, these particles are expelled from the sun in enormous numbers with great velocity.

Thus we have the comet—a gaseous body with a more or less dense nucleus—a conductor, in a constant electric stream which increases in energy as the comet approaches the sun and diminishes as it recedes. The anode is always the same, but the cathode is changing from time to time as the comet proceeds in its orbit; each cathode and the comet constantly shifting their relative positions.

As the comet approaches the sun it encounters, more and more, the resistance of the positive discharge, and this "ionic breeze" forces the comet's gaseous envelope away from the solar anode. This positive discharge consisting of material one thousand times as heavy as electrons and traveling at a tremendous velocity would afford considerable resistance.

The comet, being between an anode and a cathode, becomes electrically polarized, the portion of the nucleus, or "head," nearest the sun becomes negative and the opposite side, positive, discharging through the gaseous envelope, brushed back more or less by the "ionic breeze" from the sun, toward the strongest cathode. In fact, if there were no brushing back of the gaseous envelope the electrical disturbance would be in the direction of the cathode and the illumination would take place only in the ionized path, thus giving the effect of a "tail" or streamer. The brushing back of the envelope lengthens the streamer, and since the effect of the "ionic breeze" becomes greater as the comet approaches the sun, the streamer therefore becomes progressively longer. As the comet moves toward the sun the "tail" not only becomes longer but brighter, because the increasing heat more and more attenuates the

gaseous envelope by expansion, thus increasing its electrical conductivity; the "ionic breeze" becomes stronger and the electrical energy more intense. Should the comet get in such a position as to be under the influence of two or more planets acting as cathodes at the same time the streamer will spread out or may divide into several "tails" stretching out toward each cathode. The direction of the "tail" will depend not only on the position of the planet acting as the cathode, but it will be modified by the influence of the magnetic field it happens to be passing through at the time.

It is impossible, of course, to exactly reproduce the cometic conditions; but they can be represented fairly well with a glass tube vacuated, containing another glass tube enclosing a highly attenuated gas. When this double tube is brought within the range of an electric disturbance such as Hertzian waves or Tesla oscillations, the inner tube shows the cometic glow. The effect is very well shown if the tube is placed near the secondary of a fair-sized induction coil giving a two- or three-inch spark, the glow having, at the positive end of the inner tube, the appearance of the "head" of a comet. If the direction of the current in the coil is reversed, the "head" in the inner tube will reverse. No terminals are necessary in either tube. Thus the conditions are the same as in interstellar space, except the globule of gas is enclosed in a glass tube and is of uniform density throughout.

The properties of the luminous gas in the tube under the influence of Hertzian waves are the same as those of a gas in an ordinary Plücker tube. The direction of the luminous stream is changed when in a magnetic field perpendicular to the lines of magnetic force. If the cathode end of the tube be from you and the north pole of the magnet on your left, the stream is attracted. When the poles are reversed, it is repelled. Some gases at certain stages of rarefaction show marked stratification and form brilliant nodes when the discharge passes through them. This nodal effect is greatly intensified in a magnetic field, especially if the gas be hydrogen, carbon monoxide or carbon dioxide. By pulling a magnet perpendicular to the direction of the discharge, from one end of the tube to the other, the stream of ions is considerably lengthened, while the magnet makes little progress in pulling the light electrons against the discharge of the heavier ions.

As the comet passes through the varying magnetic fields during its flight, the effect will be manifest in varying the direction, and curvature of the "tail," and in forming nodal effects which have been frequently noticed and described as multiple "heads."

Some observers have announced that the light from certain comets is polarized. Zeeman has shown that light, when it passes through a magnetic field perpendicular to the lines of force, is plane polarized, and if it passes parallel to the lines of force it is partly plane and partly circularly polarized. Therefore it is natural to suppose that cometary light would be polarized in a manner depending on the direction of the magnetic fields through which it passes, and to an extent commensurate with the intensity of these fields.

The color of the light emitted by a comet will depend on the constituents and on the density of its gaseous envelope. The light emitted by a gas in a Plücker tube will change color as the pressure decreases, generally becoming lighter. The brightness diminishes as the voltage decreases. Thus as the comet recedes from the sun all conditions serve to diminish its luminosity, *i. e.*, the gaseous envelope condenses and the electric energy weakens until the comet ceases to emit light.

Halley's comet was reported to have lost its "tail" as it passed the earth last April. This was probably only an apparent loss. When the comet came under the dominating influence of the earth acting as the strongest cathode, the electrified stream was drawn directly toward us and we viewed it "end-on." As the comet passed beyond us the more distant planets became the cathodes and the "tail" reappeared.

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June, 1910